Legal Admissibility of Innovative Techniques of Scientific Investigation

An Honors Thesis (HONRS 499)

by

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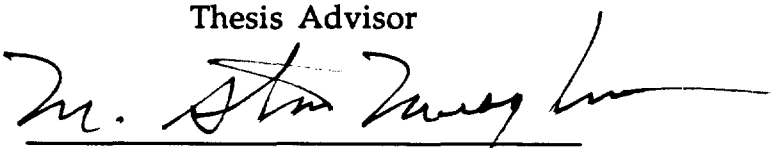

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September 15, 1992

Expected Date of Graduation: Spring, 1993

The prosecution of criminal cases relies significantly on the proper investigation of offenses. Resources available to police investigators have traditionally and continually benefitted from advances in the scientific community. There is greater interest in techniques such as DNA fingerprinting, psychological profiling of victims and offenders, and the use of video and communications apparatus. While the techniques available to investigators expand rapidly, the courts prefer to take a cautious and conservative approach to the legal admissibility of innovative scientific procedures at trial. Until judges and prosecutors deem procedures as methodologically sound, such techniques cannot be admitted as evidence in a court of law.

This project will survey judges and prosecutors in the state of Indiana to discern factors that influence the acceptance of novel techniques of scientific investigation. Judges and prosecutors will be randomly sampled based upon geographic representation and demographic composition of jurisdictions served. A survey instrument will be devised and will be self-administered with delivery and return accomplished via the mail. Results will be analyzed to determine influencing factors and ascertain if variations exist based upon geographic distribution and demographic characteristics of jurisdictions served by judges and prosecutors in the study sample.

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Chapter 1:
Statement of the Problem

Introduction

What is Forensic Science: While the biological, physical, and behavioral sciences commenced and have matured into the scientific processes of the previous five centuries, the forensic sciences have emerged from the legal processes predominantly in the twentieth century. As a forensic science, psychiatry is one of the earliest to have emanated from the legal processes, as it was used to set the precedent for criminal responsibility in The Queen v Daniel M'Naughten (1843). Concerned with determining the medical cause of death, pathology can be traced back several centuries in the operation of the legal office of the coroner. While extensive utilization of forensic science has been of late, the processes of justice have given birth to the forensic sciences over an extended period of time.

The scientific community can be separated into the 5 disciplines of health science, life science, physical science, behavioral science, and social science. As an area of evidentiary inquiry, each purports to be based upon the principles of the scientific method. As an instrument of the judicial system, each conforms the scope of its knowledge to the requirements of the law in the administration of justice. With respect to judicial fact-finding, scientific methodology has been a significant factor in aiding the administration of justice, both in rationalizing legal processes and in furthering the attainment of desired objectives. Specific objectives include the detection of crimes, identification of criminals, determination of guilt or innocence, and the imposition of punishments or penalties. The professional practitioners who utilize these sciences are judges and lawyers. Thus, their evaluation of the quality, quantity, and significance of the forensic sciences in the judicial system is of paramount interest.

The Forensic Sciences, Reflections From the Law: The legal community has declared evidence to be the key determinant of trial outcomes. Scientific evidence is thought to be intrinsically more reliable than other forms of evidence, given its physical nature and the precision of measurements performed on it by impartial, forensic science examiners. According to Peterson et al (1987),

> *This is evidence that does not forget. It is not absent because human witnesses are. It is factual evidence. Physical evidence cannot be wrong; it cannot perjure itself; it cannot be wholly absent. Only its interpretation can err. Only human failure to find it, study and understand it can diminish its value (p 1731).*

Because of the unique status attributed to scientific evidence, the judicial system has become more reliant on scientific approaches in the assessment of evidence. Since the late 1960s, the number of crime laboratories in the United States has increased threefold, facilitated primarily by three factors: (1) increasing levels of violent crime and illicit drug use; (2) landmark judicial decisions curbing questionable police interrogation practices as well as informal judicial pressure at the local level to upgrade scientific assessments of evidence; and (3) the presence of federal assistance to underwrite the expansion of laboratory facilities (Peterson et al, 1987: p 1731). With respect to this expansion in the quantity and quality of available crime laboratories, innovative techniques have been discovered whereby forensic scientists can analyze hair samples, blood samples, soil samples, semen, fingerprints, DNA composition, and myriad other forms of trace evidence which are foreign to the crime scene. It is imperative that police personnel be aware of the value of physical evidence and the techniques for collecting the same.

From prosecutorial and judicial perspectives, there exists a more favorable climate toward an increased utilization of scientific evidence. As often as prosecutors stress the added value of having physical or scientific evidence in a case, they also recognize the potential danger of proceeding with a case devoid of scientific evidence. However, as of late, there have been few specific forces to require it. The prosecutor is the critical agent at this point, and it is he who determines the evidence to be used in the adjudication of guilt or innocence. Presently, prosecutors are faced with rising caseloads and likely possess no greater scientific capacities than from a decade ago. There is a common sentiment among prosecutors that crime laboratories are overworked and understaffed, and that they should only request analysis of evidence when it is essential. Similarly, defense attorneys are no better trained scientifically and very rarely are in a position to introduce or request more scientific evidence. With respect to the judiciary, few judges have assumed an active role in assuring that scientific evidence is used more regularly in the courtroom.

Forensic Science in the Courtroom

Scientific Evidence and Criminal Trials: Scientific evidence is frequently offered in courts of law in the United States. During a time when one scientific advancement quickly facilitates another, forensic science makes a unique contribution to the charging, plea negotiation, trial, and sentencing stages of criminal case adjudication. As it is proffered for the purpose of identifying a defendant and connecting him with the scene of a crime, fingerprint evidence is one of the most widely recognized and accepted forms of scientific evidence. The first American appellate decision involving fingerprint evidence was rendered in 1911 in the case of People v Jennings (252 Ill 534, 96 NE 1077). In a well-reasoned opinion, the court held that expert testimony was not limited to classed and specific professions, but would be admissible where the witness had "peculiar knowledge or experience not common to the world, and which knowledge and experience might aid the court and jury in determining the issues." When fingerprint evidence is admitted at trial, it is most commonly used to prove that a defendant has been at a crime scene so as to facilitate an incriminating link with the overall theory of the prosecution's case.

A second contribution of the forensic sciences is the polygraph ("lie detector") technique. The polygraph machine is an instrument which measures the emotional stress that an individual exhibits when he is being questioned. The stress may be from a multitude of factors, and there is no way of objectively differentiating between nervous stress, the result of deception, and a number of other emotional responses. In the United States, the court in Frye v United States, 293 F 1013 (D.C. Cir 1923) was the first to confront the question of admissibility of polygraph evidence, which it ruled as inadmissible based upon the lack of acceptance in the scientific community. Since that time a number of other objections to polygraph evidence have been raised, among them lack of accuracy, the hearsay nature of the evidence, the violation of the privilege against self-incrimination, and the fear of undue influence on the jury. Irrespective of the guidelines of admissibility, the prevailing judicial attitude is one of a general unwillingness on the part of appellate courts to approve polygraph results as conclusive evidence.

In addition to those techniques which are recognized by the courts and may receive judicial notice as to their validity and reliability, myriad novel scientific techniques are now finding their way into the courtroom in the adjudication of criminal cases. For instance, in the area of ballistics, neutron activation analysis (NAA) and trace metal detection tests (TMDT) are slowly replacing the once-controversial diphenylamine paraffin test in order to discern whether an individual has recently fired a gun. In the examination of small items of trace evidence, microanalysis is assuming greater utilization. Microanalysis provides identification of the source of minute objects and particles, such as bits of glass, wood, soil, paint, and fibers, and the comparison of them. While the evidentiary value of some forms of trace evidence is currently under scrutiny, American courts as a general proposition have long upheld the use of microanalysis in criminal trials. Finally, as a method of identifying perpetrators of violent crime, DNA profiling is one of the most recent contributions of forensic science to be offered as evidence in any jurisdiction. Developed in England in the early 1980s, DNA testing reconstructs a descriptive physical profile by unlocking the genetic codes that can be extracted from specimens as small as a hair, a drop of blood, a skin scraping, or a spot of semen or other bodily fluids. With the exception of identical twins, each individual's DNA pattern is unique. Thus, the pattern created by the sorted fragments is unique to the test subject's DNA. Unlike other techniques, the primary issue facing DNA profiling is the development of standards for human implementation. However, once judicial recognition is acquired, its impact on the disposition of criminal cases is likely to be phenomenal, seeing that biological evidence is more commonly found at crime scenes than are usable fingerprints.

Among the many forms of scientific evidence, five categories appear most frequently in prosecutor files, those being drugs, fingerprints, firearms, blood and bloodstains, and semen. In addition, laboratories are commonly requested to test for the presence of semen in samples taken from victims of alleged rape to `establish that sexual intercourse did occur. This pattern of usage suggests that crime laboratories are most likely to analyze evidence which is mandatory for the prosecution of a case. Another major priority concerns the request for examination of evidence which has the potential of conclusively linking the defendant with a crime and with which the jurors are familiar.

From the prosecutor's perspective, there is less interest in evidence whose analysis may only partially link the defendant with a crime.

The Expert Scientific Witness: The use of expert testimony in court cases has expanded in recent years with the increasing complexity of litigation. Criminal and civil cases require expert testimony in which scientific or "informed" opinion can assist counsel to establish a position or in which the court may be assisted in determining the facts of a case. Moreover, some cases virtually cannot be tried without the assistance of experts. The significance of an expert witness to a particular case should not be underestimated. In fact,

> *If scientific, technical, or other specialized knowledge will assist the trier-of-fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert by knowledge, skill, training, or education may testify thereto in the form of an opinion or otherwise (Fed R. Evid. 702).*

In the American scheme of justice, either party may call expert witnesses, as may the court in the interest of justice. However, the latter seldom exercises this option except for psychiatric evaluations. The implication is that the expert typically appears as a "purchased" witness. Additionally, expert witnesses may agree to participate in judicial proceedings for various reasons.

According to Moenssens, Inbau, & Starrs (1986), an expert testifying as the prosecution's witness typically fulfills one of four objectives in the criminal trial: (1) to identify through fingerprint identification, firearms identification, document examination, microbiological matching of blood, hair, semen, or other trace evidence incriminating items which can be evidentially linked to the accused; (2) to prove by means of psychiatric evidence of sanity that the accused was in a particular mental or physical condition at a given time; (3) to establish the criminal circumstances of unobserved or suspicious death by means of a post-mortem autopsy examination; and (4) to impeach or rehabilitate a witness (p 13). Quite often, the prosecution expert is a full-time salaried employee of some division of the local, state, or federal government. At trial the nature of this individual's job requires that his sincerity in conducting analyses be beyond reproach. However, this desire to avoid the taint of partiality may not be so influential. Due to the nature of the adversarial system and the constant purpose of both prosecution and defense counsel,

> *Every expert who appears in court is partial to the extent that he has an expert opinion or explanation of a material fact in the dispute which he is asked to present and, if necessary, advocate by one side or another (Moenssens, Inbau, & Starrs, 1986: p 14).*

The defense expert operates on much the same premise as the prosecution expert. His allegiance is only for one case. He is typically selected by defense counsel and receives his fee from the defendant. However, in the case of an indigent client, fees come from governmental funds appropriated for that purpose. While such a provision is made, the defense does not have the advice and guidance of laboratory specialists which is freely available to prosecutors. In addition, defense counsel may not possess the scientific education, background, or understanding to know what type of expert is needed or how to locate, select, and engage such an expert. In years past, the defense in a criminal case rarely utilized its own expert testimony. Rather, defense counsel would engage the state's expert in a battle of cross-examination in an attempt to impeach the witness or to insure the validity of the evidence presented. However, unless the former's knowledge about the particular subject was as extensive as the witness', such was a hopeless endeavor. As of late, there has been a greater incentive for the defense to engage its own experts. New rules of evidence allow for a heightened discovery of prosecution evidence by defense counsel, as well as the employment of expert witnesses to examine such evidence. Moreover, with respect to indigent defendants, some jurisdictions have appropriated funds to defray the costs of such analyses and for the use of expert testimony by the defense during litigation.

Admissibility of Scientific Evidence

Frye v United States: The General Acceptance Standard: In this age of science, the fact-finding facet of the judicial system is being presented with a vast and growing body of specialization in the various fields of scientific inquiry. In the past decade, courts have faced the difficult task of ruling on the admissibility of evidence derived from a broad spectrum of newly applied scientific principles. The various techniques pose a distinct challenge to legal institutions as they "threaten to render completely obsolete many well-established and dogmatic tenets or theories of judicial proof" (Richardson, 1961: p 131). Prior rulings on the admissibility of scientific evidence have been

challenged. The judicial standard utilized in any jurisdiction may be dependent upon the type of evidence offered and the purpose sought to be achieved. With respect to the standard of admissibility itself, the Court of Appeals for the District of Columbia asserted in the case of *Frye v United States*, 293 F 1013 (D.C. Cir 1923) that

> *Just when a scientific principle or discovery crosses the line between the experimental and demonstrable stages is difficult to define. Somewhere in this twilight zone the evidential force of the principle must be recognized, and while the courts will go a long way in admitting expert testimony deduced from a well-recognized scientific principle or discovery, the thing from which the deduction is made must be sufficiently established to have gained general acceptance in the particular field in which it belongs.*

According to the Frye Standard, a novel technique must pass through an "experimental" stage during which time its validity and reliability will be rigorously tested by the scientific community. Once the technique has been successfully measured and has passed into the "demonstrable" stage, it will be accorded judicial recognition. Thus, the requirement imposed by the Frye Standard is that of *general acceptance* by the relevant scientific discipline.

One questionable aspect of the Frye Standard is whether general acceptance is required of the scientific technique or of both the underlying principle and the technique utilizing the former. If both the underlying principle and the technique must be accepted, many forms of scientific evidence would be readily excluded. Clarifying the issue involves focusing on the distinction between the validity of a technique versus the validity of the underlying theory. In many instances, the "why" and "how" of the scientific theory are not readily understood by individuals applying a new technique. However, empirical validation has recently been recognized as an acceptable method for establishing the reliability of a novel scientific technique. From this perspective, the issue then becomes one of how much empirical research is sufficient to overcome the qualms of a new technique, in which case the courts have relied upon the testimony of expert scientific witnesses in the various fields of scientific inquiry.

Extensive utilization of the Frye Standard has facilitated various problems in different jurisdictions and has led commentators to focus on the vague nature of its terminology. The

conservative nature of the Frye Standard has been criticized for excluding reliable evidence. According to Giannelli (1980),

> *A literal reading of Frye v United States would require that the courts always await the passing of a "cultural lag" during which period the new method will have had sufficient time to diffuse through scientific discipline and create a requisite body of scientific opinion needed for acceptability (p 1223).*

While the District of Columbia Circuit Court has acknowledged that the Frye Standard retards the admissibility of novel forensic techniques, it also asserts that such a consequence is not unwarranted. Moreover, other jurisdictions consider the conservative nature of the Frye test to be rather advantageous.

Contrary to the former concern, the standard may also allow for the admissibility of unreliable evidence. This defect is best illustrated by the use of the diphenylamine paraffin test, first introduced in the United States in the 1930s. As the test is designed to detect gunshot residue on the hands of an individual who has recently fired a weapon, the paraffin test was quickly adopted by law enforcement agencies. Similarly, the first reported case upholding the admissibility of the test was Commonwealth v Westwood (324 PA 289, 188 A 304; 1936). While a series of articles questioned the validity of the paraffin test, it was not until 1959, in the case of Brooke v People (139 CO 388, 339 P 2d 993; 1959), that the test was rejected. Moreover, it was not until 1967 that the first comprehensive evaluation of the paraffin test was published in scientific literature. Consequently, the test was found to be unreliable. By looking to the scientific community to assure the reliability of innovative techniques, the Frye Standard assumes that extensive testing of a technique will be conducted by that field. However, as illustrated by the use of the paraffin test, Giannelli (1980) contends that "nothing in the scientific method guarantees that hypotheses will be tested or when they will be tested" (p 1224).

Because there does not exist a common sentiment among all jurisdictions, the current status of the Frye test is difficult to assess. While some courts have rejected the main premise of the standard, many jurisdictions show considerable support for the test. With respect to the degree of interpretation, there appear to be several Frye tests. On one end of the spectrum, some courts, such as

the District of Columbia Circuit Court, have applied a strict interpretation of the test. In the middle, some courts opt to follow the precedent set forth in People v Williams (164 CA App 2d Supp 858, 331 P 2d 251), which limits the field to those experts who are familiar with the use of a particular scientific process. On the opposing end, some jurisdictions appear to have ignored the standard completely. With respect to the issue of appellate review,

> *Some courts apparently treat the general acceptance issue as a matter of law, subject to de novo review on appeal. Other courts, however, take the view that the determination of "general acceptance" is primarily a question of fact for the trial court subject to an appellate court's determination that the trial court has not abused its discretion (Giannelli, 1980: p 1222).*

While selective application of this premise has facilitated greater uncertainty, the Frye Standard has not yet been discarded.

The Federal Rules of Evidence and the Relevancy Approach: The current trend among judicial decision-makers seems to advocate a more active and searching judicial review of scientific evidence than that which is mandated by the General Acceptance Standard set forth in Frye. This inherent dissatisfaction has led to an analysis of the relevancy approach. As it is often associated with Professor Dean McCormick and the case of Coppolino v State (223 S 2d 68), the relevancy approach is best understood by the following oft-quoted passage found in McCormick's 1954 text on evidence.

> *"General scientific acceptance" is a proper condition upon the court's taking judicial notice of scientific facts, but not a criterion for the admissibility of scientific evidence. Any relevant conclusions which are supported by a qualified expert witness should be received unless there are other reasons for exclusion. Particularly, its probative value may be overborne by the familiar dangers of prejudicing or misleading the jury, unfair surprise and undue consumption of time (Giannelli, 1980: p 1233).*

From this perspective, lack of general acceptance in a particular scientific discipline should have no bearing on the trial judge's determination of admissibility. Rather, any potential disagreement among the scientific community over a specific technique should have a greater impact on the weight of the evidence as opposed to its admissibility.

The Federal Rules of Evidence help delineate the steps involved in the application of the relevancy approach. The admissibility of a novel scientific technique would require a 3-step process. First, the probative value of the evidence would be determined. Second, any inherent dangers, such

as the potential of the evidence to overwhelm the jury, would be determined. Third, the probative value would be balanced against the identified dangers. If the determination can be made that evidence which is material to the facts of the case will not be overly prejudicial to the trier-of-fact and will assist in the comprehension of the issues presented during the judicial process, then the evidence will be admitted.

The first step of the procedure requires an evaluation of the probative value of the proffered evidence. According to Federal Rule 401, relevant evidence is considered to be

> *Evidence having any tendency to make the existence of any fact that is of consequence to the determination of the action more probable or less probable than it would be without the evidence (Giannelli, 1980: p 1235).*

With respect to scientific evidence, the probative value is correlated with its reliability. If the technique is not reliable, then evidence derived from that technique is not relevant. In addition, because the judge in most instances cannot rely on logic and experience to assess the probative value of a novel scientific technique, he must turn to science. Thus, it is possible for the probative value of scientific evidence to be established through the use of expert testimony.

The second step of the procedure requires an assessment of the potential dangers associated with the evidence. According to Giannelli (1980), "the major danger of scientific evidence is its potential to mislead the jury; an aura of scientific infallibility may shroud the evidence and thus lead the jury to accept it without critical scrutiny" (p 1237). In addition, factors such as undue prejudice, confusion of the issues, and waste of time may be associated with scientific evidence. However, the latter examples are only of secondary importance with respect to the former. While a trial judge should be able to discern a jury's capacity to evaluate novel scientific techniques and appreciate how a technique involving the use of instrumentation might overwhelm a jury, he may not be able to predict the extent to which a jury will be misled. This latter aspect requires knowledge of the technique which, in its absence, renders the court dependent upon expert testimony. Under this circumstance, a general cautionary instruction should be given to the jury. Should the judge have a working knowledge of the procedure, he can then exercise a tighter rein on the expert's testimony.

The final step of the relevancy approach requires a comparison of the probative value of the proffered evidence with the potential to mislead the jury. In order to resolve this controversy, the court will often rely on expert testimony. According to Federal Rule 403, the danger of misleading the jury must substantially outweigh the probative value before exclusion will be necessary. When reviewing the issue, appellate courts will defer to the discretion of the trial court.

Similar to the Frye Standard, the primary criticism of the relevancy approach is that it fails to prohibit the admission of unreliable scientific evidence. Contrary to the former, the relevancy approach does not purport to assure the reliability of innovative techniques prior to admission. While some procedures will be excluded by the trial judge, most will pass the threshold requirements for admissibility. Courts utilizing the relevancy approach assert that scientific shortcomings will be confronted through traditional adversary trial procedures. For example, in United States v Baller (519 F 2d 463, 1975), the Court of Appeals for the Fourth Circuit contended that

> *Unless an exaggerated popular opinion of the accuracy of a particular technique makes its use prejudicial or likely to mislead the jury, it is better to admit relevant scientific evidence in the same manner as other expert testimony and allow its weight to be attacked by cross-examination and refutation (Giannelli, 1980: p 1239).*

The first assumption of the relevancy approach is that the jury is capable of evaluating novel scientific evidence, an assumption not yet proven empirically valid. Second, the relevancy approach assumes that unreliable scientific evidence will be examined in the context of criminal trials by the safeguards inherent in the adversarial process, namely notice and discovery of evidence; use of defense experts to examine evidence, advise counsel, and refute the prosecution's case; and right of due process. However, where the life or liberty of a defendant is at stake, it is crucial that findings be based upon admissible and non-prejudicial evidence. Thus, the inability of the relevancy approach to prohibit the misuse of unreliable scientific techniques renders it questionable at best.

Need for the Study

At a time when increasing specialization is considered a desirable means of solving difficult problems, legal scholars and practitioners alike realize that legal proof of criminal conduct is

rapidly becoming a "multidisciplinary mosaic of law, science, and technology" (Moenssens, Inbau, & Starrs; 1986: p 3). New scientific and experimental techniques which are finding general acceptance in their respective fields are being introduced by trial counsel in various jurisdictions in an attempt to receive judicial recognition. In addition to the impact which scientific evidence can have on an impressionable jury, the myriad functions of scientific evidence have become indispensable both in criminal investigations and in the trial of criminal cases. However, information disclosed in the laboratory serves no real purpose in law until it is presented to the trier-of-fact. At this point, lawyers are dependent upon expert testimony as an instrument for communication. Education and experience in legal administration have failed to prepare most criminal law practitioners for this task, and in many instances the prosecution and defense fail to fully utilize or even appreciate the full capacity of scientific evidence as a means of proving or disproving allegations of fact. Because of this discrepancy, additional research is necessary to determine the increasing significance which forensic science can have for criminal trials as well as to assess the factors which influence trial judges and lawyers in their acceptance of scientific evidence.

Purpose of the Study

During the twentieth century, the legal community has placed greater reliance on scientific contributions from various disciplines. With respect to criminal investigations, the police have been receptive to and have benefitted from technological advances in the physical and social sciences. However, despite such acceptance of innovative scientific techniques, there is no assurance that scientific evidence will be utilized in judicial proceedings. While the courts are receptive to new forms of scientific evidence, they are also under stringent legal guidelines in the determination of admissibility. Having satisfied the criteria for the admissibility of evidence in general, scientific evidence, or that which purports to be based upon the principles of the scientific method, must also be accompanied by considerable expert testimony. According to the precedent set in Frye v United States, 293 F 1013 (D.C. Cir 1923), there must be proof that procedures used are reliable and have received general acceptance within the respective scientific arena. While prior research has focused

upon the legal interpretation of evidence once it is deemed admissible, there is less certainty with respect to the factors which influence judges and prosecutors in their determination of the validity and reliability of new scientific procedures. Thus, following the delineation of such factors, the results of this study will assist criminal investigators and scientists alike in the presentation of supporting information which will reduce the uncertainty of the admissibility of evidence at trial.

Research Question

According to Moenssens, Inbau, & Starrs (1986), scientific evidence serves one of four purposes in the prosecution of criminal cases: (1) the identification of items of incriminating evidence which can be linked to the accused; (2) proof, through psychiatric evidence concerning sanity, toxicological evidence of blood-alcohol ratio, and the like, that the accused was in a particular mental or physical condition at a given time; (3) proof of the criminality of death by means of post-mortem examination; and (4) the impeachment or rehabilitation of a witness' testimonial credibility (p 13). While the use of scientific evidence at trial carries special requirements, several techniques have been admitted into evidence and have also received judicial recognition. In this respect, the ultimate benefit of technological advances is the acceptance of scientific evidence in judicial proceedings. Because there is an absence of substantial research on the factors which influence those who will decide on the utilization of evidence facilitated by novel scientific techniques, the admissibility of such evidence is greatly hindered. Thus, this study will focus on the following research question:

What are the factors that influence judges and prosecutors in their acceptance of innovative techniques of scientific investigation?

Chapter 2:
Review of the Literature

Legal Precautions Against Contamination of Scientific Evidence

Investigation of the Crime Scene: Evidence is the only means of satisfying the trier-of-fact of the truth or untruth of allegations made by the litigants in their pleadings. The value of physical evidence is determined by how useful it is toward verifying such issues as the commission of a crime, identification of the perpetrator, and exoneration of all other individuals under suspicion. Physical evidence had great potential in all these respects. To realize the full capacity of physical evidence, the police, the crime laboratory technician, and the prosecutor must consort to produce a set of facts which make it unreasonable to believe any other conclusion than that which is supported by the facts. In order to achieve this objective, there are certain qualities of evidence which must be attained, and some minimum quantities collected before the crime laboratory can be of any assistance. In most criminal cases, the police officers who protect and search a crime scene play a critical role in determining whether the scientific expertise of the laboratory will be utilized.

Attorneys are reliant upon the quality of evidence which has been collected and prepared by those who will testify in court. The lucid presentation of testimony by the scientific investigator must be based on thorough investigation, analysis, and documentation of the evidence. During the investigatory process, the legal provisions of a search for physical evidence cannot be violated. Evidence which is gained in a manner that clearly infringes upon a suspect's constitutional rights will not be admissible in a court of law, regardless of how incriminating it may be. The standard for admissibility of evidence is constantly changing due to appellate court and United States Supreme Court decisions. General rules mandating the admissibility of evidence include consideration of the premises to be searched and under what circumstances the search will commence. Officers cannot conduct a search without probable cause, and the search techniques must be appropriate to the situation. In both respects, the courts have intervened on numerous occasions.

Evidence is of no value to the prosecutor unless it can be used during litigation. Thus, the police must utilize great care in collecting, preserving, and identifying any physical evidence associated

with the crime. While the primary source of evidence is the crime scene, secondary sources include participants in the crime, places in which relative acts of the crime occurred, or places visited by participants. Frequently, police and other criminal investigators fail to find and protect substantial evidence, thereby restricting the use of expert analysis. The initial encounter with the crime scene is as crucial as it is neglected. The first officials on the scene are often poorly trained to see, perceive the significance of, and collect or protect vital evidence. What is not found or preserved cannot be introduced as evidence at trial.

Evidence which is located and identified during an investigation must be collected, marked for identification, and transported to a designated storage area or crime laboratory for scientific analysis. Known standards for the collection of evidence are employed at the crime scene and other areas involved in criminal operations in order to facilitate comparison analysis. To insure the admissibility of physical evidence in judicial proceedings, Weston and Wells (1990) indicate that

> *Adherence to standards and required procedures in every case is the best guarantee that the collection and possession of physical evidence will stand court tests of what happened, or could have happened, to it from the time of its finding to its presentation in court. Any deviation from standard procedures in processing physical evidence can affect its credibility and contribute to a reasonable suspicion in the minds of the triers- of-fact about the entire police investigation (p 59).*

Establishing Chain of Custody: Chain of custody is an essential quantum of proof in any case which involves such materials as bullets, cartridge cases and weapons, fingerprints, hair, drugs, bodily fluids, and various other forms of trace evidence. The chain of custody rule stipulates that the party seeking to introduce into evidence the results of an expert analysis has the burden of proving that the specimen or object analyzed was, in fact, derived or taken from the particular person or place alleged. This proof can be adduced by testimony which traces the location and custody of the specimen from the time it was secured by law enforcement officers or agents until it is offered into evidence. The chronicle of custody includes (1) the initial possession of the specimen or object by an officer; (2) the journey to the laboratory; (3) the method of storage at the laboratory prior to analysis; and (4) the retention of the unused portion of the specimen or object after analysis and up to the time of trial. With respect to specimens, it must also be established that they were the same ones

removed from the person or place in question, such that both unbroken possession and the original source can be established with certainty.

Questioning the Level of Utilization

A Look at Prior Research: While very few empirical studies have evaluated the impact of scientific evidence on the investigation and prosecution of offenses, studies concerning the use and impact of scientific evidence in judicial proceedings have been even more sparse. Kalven and Zeisel's (1966) classic research, The American Jury, included a brief summary of the use of expert witnesses at trial. No experts were present in about 3/4 of the criminal trials studied, and in only 3% of the trials did both parties utilize expert testimony. They also reported that prosecutors employed experts four times as often as defense attorneys. Parker (1963) concluded that fewer than 2% of local criminal cases benefitted from laboratory analysis of any kind. Later studies (Joseph, 1968; Benson, 1970; Rogers, 1970; Parker and Gurgin, 1972) produced similar results. Parker and Peterson (1972) discovered that only four of 3303 felony cases they examined involved the submission of evidence to a laboratory. Lasser's (1967) survey of capital cases before the Illinois supreme court found a disproportionate reliance on confessions and witness testimony at the expense of scientific evidence. Contrary to such results, Schroeder (1977) discovered an overwhelming support for the increased use of scientific evidence in the courtroom in his survey of judges and attorneys. Over 90% of the respondents expressed a desire to employ more scientific evidence, and a similar number indicated that such evidence has more credibility than lay testimony. In addition, 80% of the respondents contended that both judges and jurors give more credibility to scientific evidence than to other forms of evidence. In a similar study of American judges and trial attorneys by the National Center for State Courts (1980), 44% of the respondents stated that they encountered scientific evidence in 1/3 of their cases. A study of laboratory, police, and judicial officials in the state of New York found overwhelming support (87%) for the increased use of physical evidence in the future (Peterson et al., 1977). However, evaluations of actual rates of usage of scientific evidence found its presence to be rather uncommon in the judicial process. Finally, in a study assessing the effects of scientific evidence

on criminal investigations, Peterson et al (1984) emphasized the desirability of having physical evidence collected and examined in cases being prepared for prosecution. Moreover, data showed that "prosecutors may play a very important role in seeing that detectives present to them cases which contain essential evidence" (p 225).

Impediments in the Judicial System: Scientific evidence plays a decisive role in only a small proportion of the cases that come before the criminal courts. Despite the impact which scientific evidence can have in a few serious cases, most evidence leading to a conviction is of a common sense nature and is more self-evident to the jurors. Due to impediments inherent in the legal system, lawyers may be restricted from taking full advantage of the opportunities available to them.

The major problem that arises in the earliest stages of litigation is the location of qualified experts. While this appears to be less a problem for prosecutors and counsel in civil cases, the problem is exacerbated where a monopoly exists, such as where all available experts in a certain discipline are employed by the police laboratory or where a particular profession conspires to withhold its services. A corollary problem exists where police or criminal investigators fail to locate and protect evidence, thus limiting the assistance which experts can provide. In view of many forensic scientists, the initial encounter with the crime scene is as crucial as it is neglected. Regardless of how incriminating it may be, evidence which is not found or preserved cannot be used as such at trial.

Prior to the time of trial, the level of communication between lawyers and expert witnesses is of profound importance with respect to effective case preparation. Ironically, the problem of attorney untimeliness and lack of preparation is the most frequently cited dilemma among expert witnesses. Problems involving the direct interaction of experts and lawyers include inadequacy of mutual preparation, conflicts over fees and their payments, clarity of communications, and the collaboration of experts. The second most frequently cited concern involves inadequate discovery for the disclosure of scientific and technical evidence. With respect to scientific evidence, it appears that the more that is revealed the better. It also appears that the Federal Rules of Evidence provide a satisfactory guide. However, some lawyers feel that expanded use of depositions to discover the opinions held by

opposing experts would be advantageous. For those states which still limit the range of discovery, the court cannot be adequately informed because the parties are not engaged in direct debate. A third concern during trial preparation involves the imbalance of resources among clientele. In a system of private representation, "attorneys of unequal skill will be employed by clients of unequal means." Further, some litigants and their counsel are unable to utilize experts at all. This distribution of resources and talent in the initial stages seems to be reflected in the fact-finding and decision-making output from the system (Saks and Duizend, 1986: p 89). While the unequal resources of the parties is not limited to the use of scientific and technological experts, it appears to be especially acute where experts are employed in criminal prosecutions. A final concern reflects the missed opportunities for case resolution. While the presence of experts and definitive scientific or technological analyses during pretrial should reduce the issues to be disputed at trial or the likelihood of going to trial, the absence of such renders this a mere improbability.

Several more distinct problems contribute to limitations or distortions of information at trial. The first is the ability of the expert to convey himself in terms which have significance for the trier-of-fact. Similarly, counsel must be able to organize the presentation, elicit direct testimony, and cross-examine in a fashion that is most effective for the fact-finder. Specifically, this demands a knowledge of the technical subject matter which, in its absence, prohibits the lawyer from benefitting from or even managing the information which the expert witness can contribute in either the pretrial phase or during litigation. A second consideration is the role conflict experienced by expert witnesses. While structuring the presentation of cases in an adversary format, the law does not consider the witnesses as adversaries. Rather, the law seeks to clarify that witnesses are not supposed to facilitate any particular outcome. Their duty is to report their observations and draw inferences from such. Moreover, scientific experts seem to prefer a neutral role. Their interest in representing faithfully the concepts and findings of their disciplines surpasses their interest in seeing either party prevail. To the degree that experts function as advocates or become biased, they become a less reliable source of information for the trier-of-fact. A final consideration concerns the institutional capacity not only of judges and juries toward comprehending the technical nature of scientific

evidence, but also the instruments the court sanctions to be used for the purpose of informing the trier-of-fact. The most salient and controversial issue focuses on the Frye test. From this perspective, courts are to defer to the opinion held by the relevant scientific community. As seen in the case of U.S. v Addison, 498 F 2d 746 (D.C. Cir 1974), principles are valid when specialists believe them to be. An alternative which is more consistent with the norms of science would be for a court to examine the evidence germane to the validity of a novel technique. When the court is persuaded by the data, the procedure is valid. Currently, this is an issue of dispute and of "profound jurisprudential and practical importance."

Value of Scientific Evidence in Criminal Cases

Credibility to Judges and Juries: Scientific evidence is thought to be intrinsically more reliable than other forms of evidence, given its physical nature and the precision of measurements performed on it by impartial forensic science technicians. Despite the absence of studies demonstrating its effectiveness, police and judicial literature has mandated greater reliance on scientific evidence in court, with most practitioners and legal scholars expressing the belief that forensic evidence can have a major influence on the adjudication of criminal cases. Expert scientific opinions based on data collected at the crime scene and analyzed in the laboratory provide in myriad instances that quantum of prosecution evidence which pushes the probability of the accused's guilt *beyond a reasonable doubt,* the requisite quantum of proof for conviction. The forensic scientist can and does provide evidence substantial enough for the trier-of-fact to rely upon in assessing the issue of guilt or innocence and in rendering its judgement.

Capacity of Lay Juries to Comprehend Scientific Testimony: While the legal community considers evidence to be the key determinant during litigation, it also appreciates the potential for scientific evidence to mislead a jury. Practitioners assert that scientific evidence has a major influence on the decisions of lay jurors, noting that "an aura of scientific infallibility may shroud the evidence and thus lead the jury to accept it without critical scrutiny" (Giannelli, 1980: p 1237). Despite the opinion of some prosecutors that jurors are quite capable of evaluating most scientific

evidence presented to them, empirical support for this view is lacking. The few available studies, most involving the impact of polygraph evidence on jury deliberations (Forkosch, 1939; Koffler, 1957; Barnett, 1973; Greene, 1975; Carlson et al, 1977; Markwart & Lynch, 1979), are inconclusive. Determining the extent to which a jury will be misled by the use of scientific evidence requires an understanding of the limitations of a particular technique. As they are trained in law rather than the intricacies of the physical and social sciences, most judges and prosecutors do not possess the capacity to analyze a particular procedure, thereby increasing the court's reliance on expert testimony. Further, the ability of the jury to appreciate erroneous judgement based upon unreliable scientific evidence or the witness' allegiance with either prosecution or defense counsel is of vital importance.

Research on the Effects of Novel Scientific Techniques

Along with the increased level of specialization in the various areas of scientific inquiry, the twentieth century has witnessed the police adoption of technological advances to assist in the investigation of crime. Since 1964, the United States has placed greater emphasis on the use of physical and scientific evidence as a means of solving crimes. A vast majority of scientific evidence is obtained through the use of scientific equipment, methods, or techniques. An officer who is investigating a crime may acquire sufficient information to identify the perpetrator, but find that he has inadequate evidence to charge and obtain a conviction. Thus, the use of scientific methodology may provide the necessary quantum of proof to carry the burden of proving guilt beyond a reasonable doubt. Scientific evidence may also be the starting point which provides the link leading to the solution of a crime. It has been stated that "scientific evidence has become one of the strongest weapons available for the successful prosecution of criminal offenders" (Gardner, 1978: p 661). With respect to the use of scientific evidence in judicial proceedings, Richardson (1961) indicates that

> *The extent to which scientific evidence, produced through expert opinion or demonstratively to trial juries, or other finders of fact, has furthered the ends of justice, by shielding the innocent and revealing the guilty, is not measurable statistically in relation to earlier and less reliable methods of proof. But familiarity with the case decisions, civil and criminal, in which scientific tests and experiments*

> *have been used successfully in influencing results, leads inexorably to the conclusion that progress in fact-finding is comparable to forward strides in other areas of modern-day life (p 56).*

Polygraph Evidence in Criminal Trials: The polygraph machine is an instrument which measures the emotional stress an individual displays in response to a series of questions. The primary purpose for using the polygraph test is to ascertain the veracity of an allegation of fact. In the United States, the court in Frye v United States, 293 F 1013 (D.C. Cir 1923), was the first to confront the question of admissibility of polygraph evidence, which it ruled as inadmissible based upon the lack of acceptance in the scientific community. In addition, the District of Columbia Circuit Court set the precedent for determining the admissibility of novel scientific techniques. In order to receive judicial recognition, there must be proof that procedures used are reliable and have acquired *general acceptance* within the scientific community.

While perfection is not a criterion for the admissibility of scientific evidence, the standard has been to accord judicial recognition only after specialists have demonstrated that a technique has a reasonable degree of precision in its measurements and has been accepted within the scientific community. The prevailing judicial attitude is one of a general unwillingness on behalf of appellate courts to approve polygraph results as conclusive evidence. However, as of late an increasing number of jurisdictions have allowed polygraph results into evidence upon an agreed stipulation between the prosecutor and the defense attorney. In a court of law, polygraph evidence can be used in the following circumstances: (1) to determine whether a suspect will be charged with a crime; (2) to verify that either the complainant or the suspect is not telling the truth; (3) to establish the innocence of an individual in question; and (4) to ascertain whether a witness is telling the truth (Gardner, 1978; p 666).

Microanalysis in Criminal Litigation: The microscope was one of the earliest instruments used for the development of scientific evidence. Through microanalysis, the scientist is able to examine physical evidence under such magnifications which are not possible with only the human eye. Microanalysis provides the identification of the source of minute objects and particles, such as bits of glass, wood, soil, paint, and fibers, and the comparison of the same. In the area of criminal

investigations, microanalysis has assumed a significant role. According to Moenssens, Inbau, and Starrs (1986), the science of microanalysis can serve three primary functions: (1) an investigative aid in the apprehension of criminal offenders; (2) the elimination of innocent suspects; and (3) the establishment of guilt or innocence in a court of law (p 469). With respect to the use of microanalysis in judicial proceedings, evidentiary principles imposed by the law must be recognized. Judicial guidelines indicate that the evidence must not be contaminated or altered; it must be properly marked and identified; the chain of custody must be carefully noted; and proper investigative techniques must be followed by the expert technician.

While the evidentiary value of some forms of trace evidence is currently under scrutiny, American courts have long upheld the use of microanalysis in criminal trials. According to judicial guidelines, the witness' qualifications as an expert must be established, and the chain of custody must be traced. Once these primary components have been satisfied, the courts will sanction all manner of microanalytic evidence.

Neutron Activation Analysis in Criminal Cases: Neutron Activation Analysis (NAA) is a relatively new technique used in the identification and comparison of physical evidence. Procedurally, it is a method of determining the qualitative and quantitative elemental composition of a sample by analyzing the gamma radiation emitted following irradiation with an intense stream of nuclear particles. This bombardment ("neutron activation") produces radioactive species of most of the elements present in the sample and will reveal the identity of the trace element.

Following its development, NAA was believed to have significant forensic value in the identification of hair, paint, and soil samples to their sources of origin. Firing distance determinations were also thought to be measurable by NAA through the metallic residues deposited around bullet holes. Beginning in 1962, the NAA group at General Atomic developed an NAA method for the detection and quantitative measurement of gunshot residue on the hands of an individual who has recently fired a gun. As it is used to detect the presence and quantity of the elements antimony and barium, NAA is far more reliable than the once-controversial diphenylamine paraffin test. For a number of years, the Alcohol, Tobacco, and Firearms (ATF) Laboratory of the U.S. Treasury

Department also provided an NAA service for gunshot residue detection. Currently, the forensic uses of NAA are limited to gunshot residue analysis as well as bullet and biological specimen trace element analysis. NAA is also employed by the FBI Laboratory in the quantitative analysis of biological materials for the presence of certain toxic metals. Findings from NAA, however, must be evaluated with all other tests and facts before sound scientific opinions can be formulated.

The federal government has been using NAA since 1964. Its presence in seventy-six trials has been cited, and its introduction has been the subject of a few appellate court decisions. While judicial approval of the technique has been cautious, most of the reported opinions have upheld the admissibility of NAA results. The court in Ward v State (427 SW 2d 876, 1968) was the first to rule in favor of such evidence, as the prosecution had a chemist toxicologist testify to microscopic comparisons of pubic hairs. Since that time, numerous courts have admitted NAA evidence with little comment or objection. The identification by NAA of small particles of trace evidence is possible and highly accurate, and the technique has received general acceptance from the scientific community. While NAA has been accepted as a scientifically valid testing methodology, the technique must be performed according to an approved scientific protocol for the results to be valid. Most challenges to the procedures employed in NAA have focused not on the admissibility of the test results so much as the weight to be accorded to them by the jury. The most critical aspect of NAA is whether the results of the test are relevant to the issue in dispute.

DNA Profiling: A Legal Perspective: The discovery of a substance known as deoxyribonucleic acid (DNA) in 1869 was the first of a series of scientific events which facilitated an explosion not only in the field of biochemistry, but also in its application to forensic science. By the turn of the century, science had established that chromosomes are the carriers of all hereditary characteristics. In the 1920s, it was learned that DNA was found exclusively on the chromosomes within the nucleus, and by 1944 it was generally accepted that DNA was indeed the basic genetic material. With the exception of identical twins, each individual's DNA pattern is unique. Thus, through the process of DNA testing, the pattern created by the sorted fragments is unique to the test subject's DNA.

The application of DNA analysis to forensic science escalated following the work of geneticist Alex Jeffreys at the University of Leicester in England in the early 1980s. DNA profiling offers forensic technicians an unprecedented opportunity to obtain and present to the courts highly relevant evidence extracted from various biological specimens. Because of the capacity of DNA profiling to introduce an element close to certainty in identifying two human tissues as having the same source, it is of enormous utility both to criminal investigators and to legal counsel. In the legal context, it has the potential to reduce the issues in dispute in criminal trials by indicating definitively in an accusation of rape with whom sexual intercourse occurred. It has the capacity to link a suspect to bodily samples found at the scene of a crime. According to Robertson et al (1990),

> *It is hoped that the introduction of such clarity may serve to increase the reporting rate in low-reported crimes such as sexual assault and the conviction rate in some instances where basic scientific evidence in the past was inconclusive or ambiguous (p 159).*

While the contributions of DNA profiling are many, its significance in the administration of justice should be evaluated alongside certain legal impediments. It provides an opportunity for innocent people wrongly suspected to corroborate their innocence. For law enforcement personnel, it furnishes an enormously useful instrument for resolving certain critical issues in criminal investigations. In the disposition of criminal cases, DNA profiling can have a distinct impact upon arrest and conviction rates. Despite such merit, an impediment to the utilization of DNA technology in many jurisdictions is the inability for police to authoritatively compel suspects to provide a body tissue sample for analysis. The right against self-incrimination is inherent in the American scheme of justice. In addition, financial stringencies surrounding the high cost of utilization do not sanction DNA profiling in all circumstances. Unlike the prosecution, the defense typically does not possess the resources to examine new procedures or to have equal access to such technology. Finally, before extensive utilization of this technique can be achieved, standards for implementation will have to be developed.

DNA technology in its forensic applications is still in its infant stages. While the use of DNA profiling has been cited in nearly eighty court cases, there remains a cautious sentiment among the

judiciary. With heightened utilization, there is reason to suspect that DNA evidence will be scrutinized by the courts. According to Robertson et al (1990),

> *Judges are likely to focus upon the parameters of its claimed accuracy, the possibility of error during its testing processes, and any likelihood of bias in its reliability factors as a result of racial differences. Because of its probative value, the technique has high prejudicial potential should any of the claims made on its behalf be flawed. Thus, the onus will be on the prosecution to satisfy the courts that the likelihood of error in employing DNA technology is so minimal as not to represent any significant danger of false correlation of samples (p 174).*

So long as the procedures employed by laboratory technicians are standardized and scientifically stringent, DNA evidence should satisfy the criteria of the Frye test, and the testing procedure will likely be classed as methodologically sound. DNA profiling provides a form of evidence to judges and juries upon whose accuracy and reliability they can rely with exceptional confidence. It has already demonstrated potential to facilitate increased conviction of the guilty and less charging and conviction of the innocent. Moreover, its impact on the disposition of criminal cases is likely to be phenomenal, seeing that biological evidence is more commonly found at crime scenes than are usable fingerprints.

Chapter 3:
Methodology

The Data Base

The ultimate benefit of technological advances in the various scientific disciplines is the acceptance of scientific evidence in judicial proceedings. While prior research has focused upon the legal interpretation of evidence once it is deemed admissible, there is greater ambiguity with respect to the factors which influence judges and prosecutors in their determination of the validity and reliability of new scientific procedures. Thus, the purpose of this study is to delineate those factors that influence judges and prosecutors in their acceptance of innovative techniques of scientific investigation. The research will address two population frames. The first is that of prosecutors in the state of Indiana. There are ninety elected prosecutors in the state, and the study will incorporate the total population in the sample. The second is that of judges who preside over courts, both superior and circuit, that try felony cases in Indiana. While there are several hundred judges in such positions, the study will utilize a stratified sampling technique facilitating a sample of one-hundred superior and circuit court judges. Stratification will ensure that the sample is representative of the state with respect to geographic distribution and demographic characteristics of the jurisdictions served by judges.

Research Method

In response to the subject of inquiry, this study assumed a survey research design. A questionnaire was constructed which sanctioned the selected respondents to convey their beliefs not only of the frequency with which they encounter scientific evidence in criminal cases, but also of the significance which they feel such evidence bears for criminal law practitioners in the various stages of criminal case adjudication. Slight variations were made on the original survey instrument with respect to the status of the individual respondent (see Appendix A). Prosecutors and judges in the sample received the respective instrument along with an explanatory cover letter via the mail. A pre-posted return envelope was included with each instrument for submission of the completed

questionnaire. Approximately three weeks after the initial mailing, the return rate was assessed, following which the determination was made whether a follow-up mailing would commence.

As this study was primarily exploratory in nature, the design of the research instrument included both pre-coded items and open-ended questions, such that maximum information would be acquired. Pre-coded elements employed both Likert scale items and Guttman scale items. The research instrument was designed to measure both the prior tendencies of the respondents and their attitudes and beliefs concerning future tendencies. Questionnaire design commenced following an exhaustive review of prior efforts in this area and a review of associated literature which revealed a general acceptance of and reliance upon technological advances in the legal arena and in similar organizations that are frequently confronted with the presentation of evidence facilitated by innovative techniques of scientific investigation.

Statistical Procedures

Analysis of the returned instruments was accomplished via use of the statistical software package SPSS-X (Statistical Procedures for the Social Sciences, version 10). Univariate analysis was conducted of all responses and the personal characteristics of the respondents. To determine if there were meaningful or systematic differences among the responses of judges and prosecutors, the research utilized the non-parametric statistical procedure of Kruskal-Wallis one-way analysis of variance, with Chi Square being corrected for ties in the ranking process. This statistical procedure proved to be appropriate in light of the fact that the Likert scale employed to gauge the extent of agreement or disagreement to the various inquiries was ordinal in nature.

Chapter 4:
Data Analysis

Introduction

The study sample comprised of judges and prosecutors in the state of Indiana yielded a total of 100 valid responses and a "usable" return rate of 53.8%, one which indicates an "adequate response rate" (Babbie, 1989: p 242) and is capable of being analyzed using the statistical procedures necessitated by the research. Among the judiciary, 64 responses were obtained and 60 were deemed suitable for analysis. Four of the targeted respondents indicated that they did not try criminal cases on a frequent basis and did not feel qualified to participate the a study of this nature. For judges, the "usable" return rate was 62.5%. Among prosecutors, a total of 40 valid responses were received. However, while the total number of county prosecutors was initially believed to number 92, it was later discovered that two of the respondents serve in two jurisdictions. Thus, the potential was for 90 valid responses rather than 92. With respect to the 40 responses acquired, both the "total" and "usable" response rate among prosecutors equaled 44.4%. Concerning the status of the respondent, analysis was made of the response patterns among judges and prosecutors, as well as comparison of the trends between the same.

Use of Scientific Evidence in the Courtroom

Present Level of Utilization: A series of open-ended questions asked respondents to indicate the frequency with which they encounter scientific evidence in the courtroom setting, the potential level at which it could be employed, and the legal practitioners who utilize such evidence most frequently. Table 1 (p 29) presents the mean response for both judges and prosecutors and allows for statistical comparison of the same. Comparisons in these areas were conducted to examine any significant variation in the responses supplied by both judges and prosecutors. Kruskal-Wallis one-way analysis of variance was employed to detect any variations. Chi Square, which was corrected for ties in the ranking process, served as the test for statistical significance.

While professional practitioners have demonstrated greater reliance on advances in scientific technology, both judges and prosecutors indicated that scientific evidence is present in fewer than 50% of all criminal cases. Among the judiciary, it is perceived that scientific evidence is present in only 42% of criminal cases. For prosecutors, that figure rose to 45%. The absence of any significant variation in responses is meaningful, as it indicates a common sentiment among the two groups. Prosecutors may perceive the presence of scientific evidence to be greater due to their direct involvement in case preparation and their contact with defense counsel during pretrial in the discovery of evidence and plea negotiations.

With respect to cases devoid of scientific evidence, could it potentially play a role and have an impact on case disposition? In response to this inquiry, judges felt that 32% of such cases could employ scientific evidence. For prosecutors, this figure decreased to 21%. Despite the absence of any systematic variation, the discrepancy in responses was more distinct in this instance.

Table 1:
Use of Scientific Evidence

	Mean Judges	Mean Prosecutors	Chi Square	Level of Significance
1] Indicate the percent of criminal cases in which scientific evidence is used.	42.354	45.325	.4293	.51
2] Indicate the percent of criminal cases in which scientific evidence is not used but could potentially play a role.	31.643	21.000	2.3189	.13
3] In cases where scientific evidence is used, indicate the percent in which the prosecutor introduces the evidence.	69.170	79.659	3.1662	.08
4] In cases where scientific evidence is used, indicate the percent in which the defense counsel introduces the evidence.	23.298	14.268	4.0239	.04*

*Indicates statistically significant variation

Introduction of Scientific Evidence: While the use of expert testimony in court cases has expanded in recent years with the increasing complexity of litigation, research has indicated that the level of utilization disproportionately favors the prosecution. With respect to indigent clients, the defense typically does not have the advice and guidance of laboratory specialists which is freely available to prosecutors. Moreover, defense counsel may not possess the scientific education, background, or understanding to know what type of expert is needed or how to locate, select, or engage such an expert. In this study of judges and prosecutors, judges felt that scientific evidence is introduced by the prosecution in 69% of criminal cases and by defense counsel in 23% of criminal cases. Among prosecutors, it was indicated that they introduce scientific evidence in 80% of criminal cases, whereas defense counsel does so in 14% of criminal cases. Both groups clearly perceive that scientific evidence is more prevalent in the prosecution of a criminal case than in its defense. However, the variation among judges and prosecutors toward the frequency with which defense counsel introduces scientific evidence is significant at the .05 alpha level. Unlike the judiciary, the figure assigned by the prosecution is more conservative. Due to the time expanded during case preparation as well as the level of contact with defense counsel during pretrial in the discovery of evidence and plea negotiations, the prosecutor becomes aware of the components of the defendant's case and whether scientific evidence is present. In contrast, the judiciary assumes little or no involvement until the trial.

Restrictions on the Use of Scientific Evidence

Pattern of Responses: With the nationwide increase in the number of crime laboratories, the greater sophistication of techniques and instrumentation, and a judicial system growing more receptive to scientific evidence, one would expect to find an increase in the level of utilization. This, however, is not the case. A review of prior efforts in this area and of associated literature discovered a series of restrictions toward the use of scientific evidence. The most prominent of these are presented in Table 2 (p 32). Respondents were asked to indicate their level of agreement or disagreement with each of the stated items, using the Likert scale items of Strongly Agree, Agree, No

Opinion, Disagree, or Strongly Disagree. While "strongly agree" was not indicated as a mean response for any of the stated items among either judges or prosecutors, "lack of resources" and "lack of time for scientific analysis; backlog of evidence in crime laboratories" received the greatest level of agreement among judges and prosecutors respectively. Judges displayed a similar level of agreement toward the other factors, with "lack of understanding of the evidence" being the only factor possessing a mean response of "no opinion". Similarly, prosecutors showed a high level of agreement toward a majority of the factors, with "lack of understanding of the evidence" and "inadequate communication between police/investigators and the prosecutor" being the only factors to receive a mean response of "no opinion".

The mean response of all participants indicates a moderate level of agreement toward those factors which might prohibit the increased use of scientific evidence. While there was no indication of strong agreement toward any of the items, there was an absence of substantial disagreement to the inquiries. A majority of the responses clustered around the center of the research scale. In addition, both judges and prosecutors displayed great similarity in their response patterns. However, significant variation emerged in response to two of the five questions. According to Table 2, the mean responses for "inadequate communication between police/investigators and the prosecutor" showed significant variation at the .05 alpha level. In a similar vein, the mean responses for "lack of time for scientific analysis; backlog of evidence in crime laboratories" displayed systematic variation at the .01 alpha level. Ironically, while they assume little or no involvement prior to trial, judges showed a higher level of agreement toward the first restriction than did prosecutors. With respect to the second restriction, both groups displayed a substantial level of agreement, with prosecutors holding a slightly higher level of agreement than their counterparts, a trend which is to be expected based upon their heightened level of case involvement.

Table 2:
Restrictions on the Use of Scientific Evidence

	Mean Judges	Mean Prosecutors	Chi Square	Level of Significance
5] Lack of understanding of the evidence or procedures used to generate the evidence.	3.160	3.317	.3054	.58
6] Lack of resources to provide the evidence.	2.061	2.341	1.6503	.20
7] Improper techniques for collecting or providing the evidence.	2.640	2.825	.7153	.40
8] Inadequate communication or the flow of information between police/investigators and the prosecutor.	2.796	3.341	5.5890	.02*
9] Lack of time for scientific analysis or the backlog of evidence in crime laboratories.	2.800	2.150	7.3120	.01*

*Indicates statistically significant variation

1=Strongly Agree 2=Agree 3=No Opinion 4=Disagree 5=Strongly Disagree

Impact of Scientific Evidence on Various Decision-Makers

Distribution of Responses: In recent years, the myriad functions of scientific evidence have become indispensable both in criminal investigations and in the prosecution of criminal cases. For police investigators, scientific evidence may be the starting point which provides the link leading to the solution of a crime. For prosecutors in a criminal case, scientific evidence may provide that quantum of evidence which pushes the probability of the defendant's guilt *beyond a reasonable doubt.* For the judiciary, scientific evidence may assist in the imposition of punishments or penalties. In order to determine the level of impact which scientific evidence can have at the various stages of criminal case processing, respondents were asked to indicate their level of agreement or disagreement with respect to the different legal participants.

Table 3 lists the various decision-makers which respondents were asked to consider, as well as the mean responses for both judges and prosecutors using the Likert scale items of Strongly Agree, Agree, No Opinion, Disagree, and Strongly Disagree. While "strongly agree" was not indicated as a mean response for any of the stated items among either judges or prosecutors, the greatest level of agreement was shown in response to the choices for "prosecutors" and "jurors" by judges and prosecutors respectively. Further, both judges and prosecutors responded with a similar level of agreement in response to the other legal participants mentioned, namely police investigators, defense counsel, and the judiciary. Both judges and prosecutors displayed great similarity in their response patterns, and there was an absence of any disagreement to the inquiries. Due to the level of consistency in responses, there was an absence of any statistical significance in the level of variation.

Table 3:
Impact of Scientific Evidence on Various Decision-Makers

	Mean Judges	Mean Prosecutors	Chi Square	Level of Significance
10] Police officers/investigators involved with case preparation.	2.380	2.390	.0001	.99
11] Prosecutors responsible for the presentation of the case in court.	2.360	2.390	.0001	.99
12] Defense counsel representing the defendant in the case.	2.540	2.415	.2990	.58
13] Judges presiding over the criminal court case.	2.755	2.488	1.6950	.19
14] Jurors involved in the case.	2.420	2.200	.9586	.33

1=Strongly Agree 2=Agree 3=No Opinion 4=Disagree 5=Strongly Disagree

Impact of Scientific Evidence in the Final Disposition of Criminal Cases

Influence for Plea Negotiations: The primary effect of forensic evidence appears to be to increase the rate of arrest, charging, and conviction. Its effect on the mode of disposition (plea v trial), however, is more ambiguous. Thus, there was an interest in whether respondents believe scientific evidence has a distinct impact in the disposition of criminal cases. Using the Likert Scale items of Strongly Agree, Agree, No Opinion, Disagree, or Strongly Disagree, respondents were asked to indicate their level of agreement or disagreement with respect to the impact which they feel forensic evidence has in the various modes of disposition. Table 4 (p 35) presents a summary of the mean responses. While "strongly agree" was not presented as a mean response for any of the stated items among either judges or prosecutors, both groups felt scientific evidence has its greatest influence during plea negotiations and displayed a high level of agreement toward this response. Clearly, the impact of forensic evidence depends upon the extent to which its analysis conclusively links the defendant with the offense and the extent to which it can be explained away. While strongly associative scientific evidence may lead the defense attorney to persuade his client to enter a quick plea of guilty and reduce the likelihood of going to trial, the absence of such renders this a mere improbability.

Bench Trials v Jury Trials: While forensic evidence is believed to be an extremely powerful form of evidence, its differing level of impact for bench trials and jury trials is of paramount interest. Presentation of scientific evidence to a judge is more streamlined than to a jury. Judges may be more discriminating and critical of expert testimony and are not thought to be as persuaded by the intense cross-examination of expert witnesses. In jury trials, however, scientific evidence is thought to have a major influence on case adjudication. Jurors tend to be overly impressed by the use of scientific apparatus and are more persuaded by expert testimony. In this study, judges and prosecutors showed a greater level of agreement toward the impact of scientific evidence in jury trials. In addition, because the mean responses for both groups closely paralleled one another, there was an absence of any systematic variation once Chi Square was corrected for ties in the ranking process. Respondents feel

scientific evidence has the greatest influence during plea bargaining, followed closely by jury trials and bench trials respectively.

Table 4:
Impact of Scientific Evidence in the Final Disposition of Criminal Cases

	Mean Judges	Mean Prosecutors	Chi Square	Level of Significance
15] The presentation of scientific evidence by expert witnesses has great influence in bench trials.	2.653	2.610	.0250	.87
16] The presentation of scientific evidence by expert witnesses has great influence in jury trials.	2.180	2.098	.0212	.88
17] The presentation of scientific evidence by expert witnesses has great influence in plea bargaining	2.102	2.098	.0058	.94

1=Strongly Agree 2=Agree 3=No Opinion 4=Disagree 5=Strongly Disagree

Scientific Evidence and Criminal Case Processing

Pattern of Responses: Facts which are developed by scientific and technological evidence can have a profound impact on the processing of a criminal case: whether it is initially filed, the cost of its preparation, the strategy pursued, and whether the case goes to trial. Negotiations can succeed or fail based upon the nature of the facts developed and whether the attorneys are in command of those facts during plea negotiations. The general premise is that greater clarity of the fact situation facilitates greater predictability of the result should the case go to trial, and less likelihood that it will. Using the Likert scale items of Strongly Agree, Agree, No Opinion, Disagree, or Strongly Disagree, respondents were asked to indicate their level of agreement or disagreement toward the impact which they feel scientific evidence has in a few select stages of criminal case processing,

namely investigation of the crime scene, presentation of the case to the grand jury, and preparation of a presentence investigation report (PSI) by a probation officer.

Table 5 lists the stages which respondents were asked to consider, as well as the mean responses for both judges and prosecutors. Respondents identified "investigation of the crime scene" as the stage at which forensic evidence can have its greatest impact, with judges holding a slightly higher level of agreement than prosecutors. A similar level of agreement was shown by both groups toward "presentation of a case to the grand jury", with the mean response for judges being slightly higher than prosecutors. A mean response of "no opinion" emerged from both groups in response to "preparation of a PSI by a probation officer", indicating both agreement and disagreement on the research scale. The distribution of responses accumulated around the center of the Likert scale, and there was an absence of any systematic variation.

Table 5:
Impact of Scientific Evidence Throughout the Processing of a Criminal Case

	Mean Judges	Mean Prosecutors	Chi Square	Level of Significance
18] The potential availability of scientific evidence influences the manner in which police investigate a case.	2.140	2.195	.0236	.88
19] The availability of scientific evidence influences the presentation of a criminal case to the grand jury.	2.320	2.366	.0120	.91
20] The availability of scientific evidence influences the preparation of a presentence investigation report by a probation officer.	3.320	3.512	.6576	.42

1=Strongly Agree 2=Agree 3=No Opinion 4=Disagree 5=Strongly Disagree

Role of Scientific Evidence in the Courtroom

Distribution of Responses: While the numerous functions of scientific evidence have become indispensable both in the prosecution and defense of criminal cases, it has also been indicated that scientific evidence is present in fewer than 50% of all criminal cases. With respect to the cases which employ forensic evidence, it is interesting to note the relative impact which it can have on case adjudication, as well as the tactics which are used to challenge scientific evidence.

Previous responses by judges and prosecutors indicate the perception that prosecutors introduce scientific evidence nearly three times as often as defense counsel. Is it probable that defense counsel will refute the prosecution's evidence with a similar level of consistency? Using the Likert scale items of Strongly Agree, Agree, No Opinion, Disagree, or Strongly Disagree, respondents were asked to indicate their level of agreement or disagreement toward this inquiry. As shown in Table 6 (p 38), both judges and prosecutors revealed a high level of agreement toward the frequency with which the prosecution and defense will refute evidence presented by opposing counsel, with judges displaying a slightly higher level of agreement in both instances. Due to the level of consistency in responses, there was an absence of any statistical significance in the level of variation.

Defense attorneys reveal a variety of tactics which are used to challenge forensic evidence, ranging from efforts to have the evidence ruled inadmissible (on the premise of search and seizure or chain of custody) to attacks on the expert's qualifications or intense cross-examination of the expert's conclusions. Typically, however, defense counsel will attempt to "explain away" the evidence by providing a reasonable and lawful explanation for its presence. When such tactics fail, defense counsel will usually stipulate to the evidence and attempt to draw minimal attention to it. In this study of judges and prosecutors, respondents were asked to consider such tactics and indicate the level at which defense counsel is successful when employing the same.

Table 6 presents the mean responses supplied by both judges and prosecutors toward a series of inquiries of this nature. Interestingly, systematic variation was discovered in two of the three instances, as Chi Square proved to be significant at the .01 alpha level. When asked whether the defense is successful in refuting scientific evidence for the prosecution, judges provided a mean

response of "no opinion", indicating an absence of either strong agreement or disagreement. Among prosecutors, a moderate level of agreement was shown. While both mean responses clustered around the center of the research scale, the variation which emerged was statistically significant.

Table 6:
Role of Scientific Evidence in the Courtroom

	Mean Judges	Mean Prosecutors	Chi Square	Level of Significance
21] When the prosecution introduces scientific evidence, defense counsel will attempt to refute the evidence.	1.980	2.000	.5270	.47
22] When defense counsel introduces scientific evidence, the prosecutor will attempt to refute the evidence.	1.940	2.051	1.2359	.27
23] When only the prosecution introduces scientific evidence, the prosecution achieves an advantage at trial.	2.200	2.171	.2897	.59
24] When only the defense introduces scientific evidence, the defense achieves an advantage at trial.	2.327	2.325	.0237	.88
25] The defense is successful in refuting scientific evidence presented by the prosecution.	3.130	2.639	8.4459	.00*
26] The defense is successful in attacking the credibility of expert witnesses for the prosecution.	2.957	3.459	8.0203	.00*
27] The defense comprehends the nature of scientific evidence presented by the prosecution.	2.149	2.342	1.6210	.20

*Indicates statistically significant variation

1=Strongly Agree 2=Agree 3=No Opinion 4=Disagree 5=Strongly Disagree

A similar tactic utilized by defense counsel would be to attack the credibility of the prosecution's expert witness through intense cross-examination of his qualifications or his conclusions. Using the Likert scale items of Strongly Agree, Agree, No Opinion, Disagree, or Strongly Disagree, respondents were asked to indicate their level of agreement or disagreement toward the perceived utility of this tactic. While the level of variation was quite similar to the previous inquiry and was significant at the .01 alpha level, the response pattern was quite the opposite. Among the judiciary, a moderate level of agreement was apparent. For prosecutors, however, a mean response of "no opinion" emerged, indicating a lack of either agreement or disagreement. While judges and prosecutors differ in their beliefs, it is clear that neither group perceives the utility of such tactics for defense counsel.

Chapter 5:
Conclusion

The prosecution of criminal cases relies significantly on the proper investigation of offenses. Resources available to police investigators have traditionally and continually benefitted from advances in the physical and social sciences. There is a heightened interest in techniques such as DNA fingerprinting, psychological profiling of offenders and victims, and the use of video and communications apparatus. While techniques available to investigators expand rapidly, the courts prefer to take a cautious and conservative approach to the legal admissibility of new techniques at trial. Until judges and prosecutors have deemed procedures as methodologically sound, the techniques cannot be admitted as evidence in a court of law.

While prior research has focused upon the legal interpretation of evidence once it is deemed admissible, there is less certainty with respect to the factors which influence judges and prosecutors in their determination of the validity and reliability of new scientific procedures. For this reason, the utilization of such evidence is greatly hindered. This study has attempted to focus upon the factors which influence judges and prosecutors in their acceptance of innovative techniques of scientific investigation. A questionnaire was designed which sanctioned the selected respondents to convey their beliefs not only of the frequency with which they encounter scientific evidence in criminal cases, but also of the significance which they feel such evidence bears for criminal law practitioners in the various stages of case adjudication. Slight variations were made on the original survey instrument such that analysis could be made of the response pattern among judges and prosecutors, as well as comparison of the trends between the same.

Concerning the rate of utilization, both judges and prosecutors indicated that scientific evidence is present in fewer than 50% of all criminal cases, a finding which is significant given the recent advances in scientific technology. With respect to cases devoid of forensic evidence, respondents perceived that nearly 1/3 could potentially employ such evidence. Unlike the advice and guidance of laboratory specialists which is freely available to prosecutors, defense counsel may not possess the

resources necessary to locate, select, or engage such an expert. Thus, respondents indicated that the prosecution introduces scientific evidence nearly three times as often as defense counsel.

A review of prior efforts in this area and of associated literature has revealed a series of restrictions toward the heightened use of scientific evidence. The most prominent of these include (1) lack of understanding of the evidence or procedures used to generate the evidence; (2) lack of resources to provide the evidence; (3) improper techniques for collecting the evidence; (4) inadequate communication or the flow of information between police/investigators and the prosecutor; and (5) lack of time for scientific analysis or the backlog of evidence in crime laboratories. Respondents displayed a substantial level of agreement toward each of the factors, with a majority of the responses clustered around the center of the research scale. Significant variation emerged in response to two of the five items, with Chi Square being significant at both the .05 and .01 alpha levels. This degree of variation is of interest, as it indicates a sharp difference in the response pattern for judges and prosecutors.

A consistently high level of agreement emerged toward the impact which scientific evidence can have for various legal practitioners in the various stages of case adjudication. It is clear that forensic evidence can have a profound impact on the processing of a criminal case: whether it is initially filed, the cost of its preparation, the strategy pursued, and whether the case goes to trial. Participants such as police investigators, prosecutors, defense counsel, jurors, and the judiciary clearly benefit from the utilization of scientific evidence prior to and throughout the trial process.

For the prosecutor in charge of a criminal case, the utility of forensic evidence lies in its ability to conclusively link the defendant with the crime and increase the rate of conviction. For defense counsel who typically does not have the advice and guidance of laboratory specialists which is freely available to prosecutors, an attempt must be made either to refute the incriminating evidence and attack the credibility of the prosecution's expert witness, or stipulate to the evidence. Among judges and prosecutors, a consistent level of agreement emerged in response to the various inquiries, indicating the perception that defense counsel achieves only a moderate level of success in its utilization of such tactics during the trial process.

In summary, the twentieth century has witnessed a greater reliance on scientific technology by the legal community. With respect to criminal investigations, the police have been receptive to and have benefitted from technological advances in the physical and social sciences. Despite such acceptance of innovative scientific techniques, there is no assurance that forensic evidence will be utilized in judicial proceedings. While the courts are receptive to new forms of scientific evidence, they are also under stringent legal guidelines in the determination of its admissibility. Having satisfied the criteria for the admissibility of evidence in general, scientific evidence, or that which purports to be based upon the principles of the scientific method, must also be accompanied by considerable expert testimony. While prior research has focused upon the legal interpretation of evidence once it is deemed admissible, there is greater ambiguity with respect to the factors which influence judges and prosecutors in their determination of the validity and reliability of new scientific procedures. This study has attempted to clarify these issues by addressing both judges and prosecutors in the state of Indiana. Continued research in this area will assist police investigators and forensic scientists to present information to judges and prosecutors in the attempt to gain acceptance of novel scientific techniques. Further, recognizing the factors that contribute to the decision-making processes of these individuals will facilitate the presentation of supporting information that will reduce the uncertainty of the admissibility of evidence at trial.

Works Cited

Anderson, Patrick R.; Winfree, L. Thomas Jr. Expert Witnesses: Criminologists in the Courtroom. Albany, NY: State University of New York Press, 1987.

Black, Bert. "Evolving Legal Standards for the Admissibility of Scientific Evidence." Science. 239(4847). 1508-1512, 1988.

Commentary, "Evidence - Admissibility of Scientific Evidence - Fifth Circuit Limits Permissible Scientific Evidence to Generally Accepted Theories." Harvard Law Review. 105(3). 791-796, 1992.

Commentary, "Evidentiary Uses of Neutron Activation Analysis." California Law Review. 59(1971). 997-1080.

Commentary, "Expert Testimony Based on Novel Scientific Techniques: Admissibility Under the Federal Rules of Evidence." George Washington Law Review. 48(1980). 774-790.

Fox, R.H.; Cunningham, C.L. Crime Scene Search and Physical Evidence Handbook. U.S. Department of Justice, National Institute of Law Enforcement and Criminal Justice, 1973.

Gardner, Thomas J. Criminal Evidence: Principles, Cases, and Readings. St. Paul, MN: West Publishing Company, 1978.

Giannelli, Paul. "The Admissibility of Novel Scientific Evidence: Frye v United States, A Half-Century Later." Columbia Law Review. 80(1980). 1197-1250.

Imwinkelried, Edward. "A Comparative Law Analysis of the Standard for Admitting Scientific Evidence: The United States Stands Alone." Forensic Science International. 42(1,2) 15-31, 1989.

Klotter, John C. Criminal Evidence. Third Edition. Cincinnati, OH: Anderson Publishing Company, 1980.

Markle, Arnold. Criminal Investigation and Presentation of Evidence. St. Paul, MN: West Publishing Company, 1976.

Moenssens, Andre A.; Inbau, Fred E.; Starrs, James E. Scientific Evidence in Criminal Cases. Third Edition. Mineola, NY: Foundation Press, 1986.

Parker, B.; Peterson, J.L. Physical Evidence Utilization in the Administration of Criminal Justice. Washington D.C.: U.S. Government Printing Office, 1972.

Peterson, Joseph L. Forensic Science: Scientific Investigation in Criminal Justice. Washington D.C.: AMS Press, 1975.

Peterson, Joseph L.; Mihajlovic, Steven; Gilliland, Michael. Forensic Evidence and the Police: The Effects of Scientific Evidence on Criminal Investigations. Washington D.C.: U.S. Department of Justice, National Institute of Justice, 1984.

Peterson, Joseph L.; Ryan, John P.; Houlden, Pauline; Mihajlovic, Steven. Forensic Science and the Courts: The Uses and Effects of Scientific Evidence in Criminal Case Processing - Final Report. Washington D.C.: U.S. Department of Justice, National Institute of Justice, 1986.

_____. "The Uses and Effects of Forensic Science in the Adjudication of Felony Cases." Journal of Forensic Science. 32(6). 1730-1753, 1987.

Richardson, James R. Modern Scientific Evidence: Civil and Criminal. Cincinnati, OH: W.H. Anderson Publishing Company, 1961.

Robertson, J.; Ross, A.M.; Burgoyne, L.A. DNA in Forensic Science: Theory, Techniques, and Application. Great Britain: Ellis Horwood Limited, 1990.

Saks, Michael J.; Duizend, Richard V. "Scientific Evidence in Litigation: Problems, Hopes, Accommodations, and Frustrations." State Court Journal. 7(1). 5-7, 23-28; 1983.

_____. Use of Scientific Evidence in Litigation. Williamsburg, VA: National Center for State Courts. U.S. Department of Justice, Office of Justice Assistance, 1983.

_____. Use of Scientific and Technological Evidence in Litigation: Final Report. Williamsburg, VA: National Center for State Courts. U.S. Department of Justice, Office of Justice Assistance, 1986.

Schroeder, Oliver. Assessment of the Forensic Science Profession: A Legal Study Concerning the Forensic Science Personnel. Volume III. Washington D.C.: U.S. Department of Justice, National Institute of Law Enforcement and Criminal Justice, 1977.

Smith, Roger. "Forensic Pathology, Scientific Expertise, and the Criminal Law." In: Expert Evidence: Interpreting Science in the Law. London and New York: Routledge, 1989. 56-92.

Suggs, D.L. "Use of Psychological Research by the Judiciary: Do the Courts Adequately Assess the Validity of the Research?" Law and Human Behavior. 3(1979). 135-148.

Visher, Christy. "Juror Decision-Making: The Importance of Evidence." Law and Human Behavior. 11(1). 1-17, 1987.

Weston, Paul; Wells, Kenneth. Criminal Investigations: Basic Perspectives. Fifth Edition. Englewood Cliffs, NJ: Prentice Hall, 1990.

Wigmore, John H. A Students' Textbook of the Law of Evidence. Brooklyn, NY: Foundation Press, Inc., 1935.

Appendix A:
Questionnaires

JUDICIAL SURVEY REGARDING SCIENTIFIC EVIDENCE

USE OF SCIENTIFIC EVIDENCE

1. Indicate the percent of criminal cases in which scientific evidence is used.

   _____%

2. Indicate the percent of criminal cases in which scientific evidence is not used but could potentially play a role.

   _____%

3. In cases where scientific evidence is used, indicate the percent in which the PROSECUTOR introduces the evidence.

   _____%

4. In cases where scientific evidence is used, indicate the percent in which the DEFENSE COUNSEL introduces the evidence.

   _____%

RESTRICTIONS ON THE USE OF SCIENTIFIC EVIDENCE

For the following items, indicate your agreement or disagreement by checking the appropriate box.

SA = Strongly Agree
A = Agree
NA = Not Applicable/No Opinion
D = Disagree
SD = Strongly Disagree

Scientific evidence is restricted in use in the legal process for the following reasons:

5. Lack of understanding of the evidence or procedures used to generate the evidence.	[SA]	[A]	[NA]	[D]	[SD]
6. Lack of resources to provide the evidence.	[SA]	[A]	[NA]	[D]	[SD]
7. Improper techniques for collecting or providing the evidence.	[SA]	[A]	[NA]	[D]	[SD]
8. Inadequate communication or the flow of information between police/investigators and the prosecutor.	[SA]	[A]	[NA]	[D]	[SD]
9. Lack of time for scientific analysis or the backlog of evidence in crime laboratories.	[SA]	[A]	[NA]	[D]	[SD]

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COMPREHENSION OF SCIENTIFIC EVIDENCE IN THE LEGAL SETTING

For the following items, indicate your agreement or disagreement by checking the appropriate box.

Considering various decision-makers in the legal process, scientific evidence presented by expert witnesses has a greater impact than evidence presented by other witnesses for:

10. Police officers/investigators involved with case preparation.	[SA]	[A]	[NA]	[D]	[SD]
11. Prosecutors responsible for the presentation of the case in court.	[SA]	[A]	[NA]	[D]	[SD]
12. Defense counsel representing the defendant in the case.	[SA]	[A]	[NA]	[D]	[SD]
13. Judges presiding over the criminal court case.	[SA]	[A]	[NA]	[D]	[SD]
14. Jurors involved in the case.	[SA]	[A]	[NA]	[D]	[SD]

Considering the impact of scientific evidence in the final disposition of criminal cases, respond to the following statements.

15. The presentation of scientific evidence by expert witnesses has great influence in BENCH TRIALS.	[SA]	[A]	[NA]	[D]	[SD]
16. The presentation of scientific evidence by expert witnesses has great influence in JURY TRIALS.	[SA]	[A]	[NA]	[D]	[SD]
17. The presentation of scientific evidence by expert witnesses has great influence in PLEA BARGAINING.	[SA]	[A]	[NA]	[D]	[SD]

Considering the impact of scientific evidence throughout the processing of a criminal case, respond to the following statements.

18. The potential availability of scientific evidence influences the manner in which police investigate a criminal case.	[SA]	[A]	[NA]	[D]	[SD]
19. The availability of scientific evidence influences the presentation of a criminal case to the grand jury.	[SA]	[A]	[NA]	[D]	[SD]
20. The availability of scientific evidence influences the preparation of a presentence investigation report by a probation officer.	[SA]	[A]	[NA]	[D]	[SD]

ROLE OF SCIENTIFIC EVIDENCE IN THE COURTROOM

21. When the PROSECUTOR introduces scientific evidence, DEFENSE COUNSEL will attempt to refute the evidence.	[SA]	[A]	[NA]	[D]	[SD]
22. When DEFENSE COUNSEL introduces scientific evidence, the PROSECUTOR will attempt to refute the evidence.	[SA]	[A]	[NA]	[D]	[SD]

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23. When only the PROSECUTOR introduces scientific evidence, the prosecution achieves an advantage at trial.	[SA]	[A]	[NA]	[D]	[SD]
24. When only the DEFENSE introduces scientific evidence, the defense achieves an advantage at trial.	[SA]	[A]	[NA]	[D]	[SD]
25. The DEFENSE is successful in refuting scientific evidence presented by the prosecution.	[SA]	[A]	[NA]	[D]	[SD]
26. The DEFENSE is successful in attacking the credibility of expert witnesses for the prosecution.	[SA]	[A]	[NA]	[D]	[SD]
27. The DEFENSE comprehends the nature of scientific evidence presented by the prosecution.	[SA]	[A]	[NA]	[D]	[SD]

BACKGROUND INFORMATION

In what county do you serve? _____

How long have you been a criminal court judge? _____ years

Please indicate your age. _____ years

Please indicate your gender. [ ] Male [ ] Female

Please Provide Any Additional Comments: _____

_____

_____

_____

Please place the completed questionnaire in the pre-posted return envelope and drop in the mail. Thank-you for your time and effort.

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PROSECUTORIAL SURVEY REGARDING SCIENTIFIC EVIDENCE

USE OF SCIENTIFIC EVIDENCE

1. Indicate the percent of criminal cases in which scientific evidence is used.

   _____%

2. Indicate the percent of criminal cases in which scientific evidence is not used but could potentially play a role.

   _____%

3. In cases where scientific evidence is used, indicate the percent in which the PROSECUTOR introduces the evidence.

   _____%

4. In cases where scientific evidence is used, indicate the percent in which the DEFENSE COUNSEL introduces the evidence.

   _____%

RESTRICTIONS ON THE USE OF SCIENTIFIC EVIDENCE

For the following items, indicate your agreement or disagreement by checking the appropriate box.

SA = Strongly Agree
A = Agree
NA = Not Applicable/No Opinion
D = Disagree
SD = Strongly Disagree

Scientific evidence is restricted in use in the legal process for the following reasons:

5. Lack of understanding of the evidence or procedures used to generate the evidence.	[SA]	[A]	[NA]	[D]	[SD]
6. Lack of resources to provide the evidence.	[SA]	[A]	[NA]	[D]	[SD]
7. Improper techniques for collecting or providing the evidence.	[SA]	[A]	[NA]	[D]	[SD]
8. Inadequate communication or the flow of information between police/investigators and the prosecutor.	[SA]	[A]	[NA]	[D]	[SD]
9. Lack of time for scientific analysis or the backlog of evidence in crime laboratories.	[SA]	[A]	[NA]	[D]	[SD]

GO TO NEXT PAGE →

COMPREHENSION OF SCIENTIFIC EVIDENCE IN THE LEGAL SETTING

For the following items, indicate your agreement or disagreement by checking the appropriate box.

Considering various decision-makers in the legal process, scientific evidence presented by expert witnesses has a greater impact than evidence presented by other witnesses for:

10. Police officers/investigators involved with case preparation.	[SA]	[A]	[NA]	[D]	[SD]
11. Prosecutors responsible for the presentation of the case in court.	[SA]	[A]	[NA]	[D]	[SD]
12. Defense counsel representing the defendant in the case.	[SA]	[A]	[NA]	[D]	[SD]
13. Judges presiding over the criminal court case.	[SA]	[A]	[NA]	[D]	[SD]
14. Jurors involved in the case.	[SA]	[A]	[NA]	[D]	[SD]

Considering the impact of scientific evidence in the final disposition of criminal cases, respond to the following statements.

15. The presentation of scientific evidence by expert witnesses has great influence in BENCH TRIALS.	[SA]	[A]	[NA]	[D]	[SD]
16. The presentation of scientific evidence by expert witnesses has great influence in JURY TRIALS.	[SA]	[A]	[NA]	[D]	[SD]
17. The presentation of scientific evidence by expert witnesses has great influence in PLEA BARGAINING.	[SA]	[A]	[NA]	[D]	[SD]

Considering the impact of scientific evidence throughout the processing of a criminal case, respond to the following statements.

18. The potential availability of scientific evidence influences the mannerin which police investigate a criminal case.	[SA]	[A]	[NA]	[D]	[SD]
19. The availability of scientific evidence influences the presentation of a criminal case to the grand jury.	[SA]	[A]	[NA]	[D]	[SD]
20. The availability of scientific evidence influences the preparation of a presentence investigation report by a probation officer.	[SA]	[A]	[NA]	[D]	[SD]

ROLE OF SCIENTIFIC EVIDENCE IN THE COURTROOM

21. When the PROSECUTOR introduces scientific evidence, DEFENSE COUNSEL will attempt to refute the evidence.	[SA]	[A]	[NA]	[D]	[SD]
22. When DEFENSE COUNSEL introduces scientific evidence, the PROSECUTOR will attempt to refute the evidence.	[SA]	[A]	[NA]	[D]	[SD]

GO TO NEXT PAGE →

23. When only the PROSECUTOR introduces scientific evidence, the prosecution achieves an advantage at trial. [SA] [A] [NA] [D] [SD]

24. When only the DEFENSE introduces scientific evidence, the defense achieves an advantage at trial. [SA] [A] [NA] [D] [SD]

25. The DEFENSE is successful in refuting scientific evidence presented by the prosecution. [SA] [A] [NA] [D] [SD]

26. The DEFENSE is successful in attacking the credibility of expert witnesses for the prosecution. [SA] [A] [NA] [D] [SD]

27. The DEFENSE comprehends the nature of scientific evidence presented by the prosecution. [SA] [A] [NA] [D] [SD]

BACKGROUND INFORMATION

In what county do you serve? _____

How long have you been involved in criminal prosecution? _____ years

Please indicate your age. _____ years

Please indicate your gender. [ ] Male [ ] Female

Please Provide Any Additional Comments: _____

_____

_____

_____

Please place the completed questionnaire in the pre-posted return envelope and drop in the mail. Thank-you for your time and effort.

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Appendix B:
Codebook

Codebook

Column	Variable Name	Variable Label	Values
1-3	STAT	Judge or Prosecutor	1=Judge 2=Prosecutor 3=Missing
4-6	Q1	Percent Cases Evidence Used	Anything Valid 999: Missing
7-9	Q2	Percent Cases Not Used But Potential	Anything Valid 999: Missing
10-12	Q3	Percent Cases Prosecutor Introduces	Anything Valid 999: Missing
13-15	Q4	Percent Cases Defense Introduces	Anything Valid 999: Missing
16	Q5	Lack of Understanding	1=Strongly Agree 2=Agree 3=No Opinion 4=Disagree 5=Strongly Disagree 9=Missing
17	Q6	Lack of Resources	Same as Q5
18	Q7	Improper Collection of Evidence	Same as Q5
19	Q8	Inadequate Communication	Same as Q5
20	Q9	Lack of Time; Backlog of Evidence	Same as Q5
21	Q10	Impact: Police Officers	Same as Q5
22	Q11	Impact: Prosecutors	Same as Q5
23	Q12	Impact: Defense Counsel	Same as Q5
24	Q13	Impact: Judiciary	Same as Q5
25	Q14	Impact: Jurors	Same as Q5
26	Q15	Influence in Bench Trials	Same as Q5
27	Q16	Influence in Jury Trials	Same as Q5
28	Q17	Influence in Plea Bargaining	Same as Q5
29	Q18	Influence on Police Investigation	Same as Q5
30	Q19	Influence on Grand Jury	Same as Q5
31	Q20	Influence on Preparation of PSI	Same as Q5
32	Q21	Defense Counsel Refutes	Same as Q5
33	Q22	Prosecutor Refutes Evidence	Same as Q5
34	Q23	Prosecutorial Advantage	Same as Q5
35	Q24	Defense Counsel Advantage	Same as Q5
36	Q25	Defense Successful in Refuting	Same as Q5
37	Q26	Defense Successful in Attacking Credibility	Same as Q5
38	Q27	Defense Comprehension	Same as Q5

Column	Variable Name	Variable Label	Values
39-40	Demographic	County 1	01-92; 99: Missing
41-42	Demographic	County 2	01-92; 99: Missing
43-44	Demographic	Years of Service	Anything Valid; 99: Missing
45-46	Demographic	Age	Anything Valid; 99: Missing
47	Demographic	Gender	1=Male 2=Female 9=Missing

Indiana County Codes:

01: Adams County
02: Allen County
03: Bartholomew County
04: Benton County
05: Blackford County
06: Boone County
07: Brown County
08: Carroll County
09: Cass County
10: Clark County
11: Clay County
12: Clinton County
13: Crawford County
14: Daviess County
15: Dearborn County
16: Decatur County
17: Dekalb County
18: Delaware County
19: Dubois County
20: Elkhart County
21: Fayette County
22: Floyd County
23: Fountain County
24: Franklin County
25: Fulton County
26: Gibson County
27: Grant County
28: Greene County
29: Hamilton County
30: Hancock County
31: Harrison County
32: Hendricks County
33: Henry County
34: Howard County
35: Huntington County
36: Jackson County
37: Jasper County
38: Jay County
39: Jefferson County
40: Jennings County
41: Johnson County
42: Knox County
43: Kosciusko County
44: LaGrange County
45: Lake County
46: La Porte County
47: Lawrence County
48: Madison County
49: Marion County
50: Marshall County
51: Martin County
52: Miami County
53: Monroe County
54: Montgomery County
55: Morgan County
56: Newton County
57: Noble County
58: Ohio County
59: Orange County
60: Owen County
61: Parke County
62: Perry County
63: Pike County
64: Porter County
65: Posey County
66: Pulaski County
67: Putnam County
68: Randolph County
69: Ripley County
70: Rush County
71: St. Joseph County
72: Scott County
73: Shelby County
74: Spencer County
75: Starke County
76: Steuben County
77: Sullivan County
78: Switzerland County
79: Tippecanoe County
80: Tipton County
81: Union County
82: Vanderburgh County
83: Vermillion County
84: Vigo County
85: Wabash County
86: Warren County
87: Warrick County
88: Washington County
89: Wayne County
90: Wells County
91: White County
92: Whitely County